Repository asset audit

Mª Esperanza Manso Martínez[☆]
manso@infor.uva.es

Mª Pilar Romay Rodríguez[☆]
promay@infor.uva.es

Francisco J.García Peñalvo[♣]
fgarcía@gugu.usal.es

Abstract

The audit is a process that allows an independent evaluation of software products, or processes, in order to certificate objectively their compliance according to a set of principles and rules. The aim of this work is to propose an audit in order to control the documentation just before the input into a repository. We will focus on the kind of documentation created under OMT and using UML.

Keywords

Audit, checklist, metric, standard.

1. Introduction

According to the quality plan of GIRO (Manso, E. et al, 1998), when an asset arrives to the repository must be audited in order to control its documentation. We know that, at the moment, in most cases the asset was developed with object-oriented methodology using OMT method and UML language. This is the reason for we choose them when defining the first checklists of audit.

In order to develop the audit we have followed the IEEE standards. Reviews will be the principal mechanism for the audit we describe here. According to the standard IEEE (IEEE, std 1028, 1994) an audit is defined as:
"An independent evaluation of software products or processes to ascertain compliance to standards, guidelines, specifications, and procedures based on objective criteria that include documents that specify

(1) The form or content of the products to be produced
(2) The process by which the products shall be produced
(3) How compliance to standards or guidelines shall be measured"

The objective of this audit is to obtain a certified documentation in order to guarantee its correctness and completeness. First of all we inquire into the asset completeness in the sense that all mandatory documents for the used method are present, in addition we look for the presence of verification & validation documents. Second, we inquire into asset syntax or representation correctness. In any case we are going to conclude, using measures, if the asset is qualified approval or not. The audited asset is qualitatively different from the input asset, quality increase is the result of the audit effort.

The remainder of this paper is organised as follows. In section 2 an overview to the elements audit is presented. In section 3 the results obtained when we have carry out the audit in a set of assets are showed. The section 4 closes the paper with a short summary and the current and future work.

2. Audit elements

Following IEEE standards, as we have referred above, the elements that define the audit are Input, Entry criteria, Procedures, Overview, Preparation, Examination, Reporting, Exit criteria and Output. We are going to comment how some relevant elements are specified in this audit.

✓*Input*: the objective of these audit criteria will be checklists, plans, procedures and standards. A remarkable procedure we want to mention is the planning. The audit responsible people will be the repository administrator, quality staff and, depending on the asset type, some expert person could incorporate. The checklist specifies the measures to collect.

☆ Departamento de informática. Edificio de Tecnologías de la Información y Telecomunicaciones. Universidad de Valladolid. Paseo del Cementerio S/N, 47011 Valladolid (España)
♣ Departamento de Informática y Automática. Facultad de Ciencias. Universidad de Salamanca. Plaza de la Merced S/N. 37008, Salamanca (España)

Furthermore, there will have documentation specifying the reports that must be done and, who and how to do them.
The *Checklist* is the kernel of the audit. Depending on the asset's development phase and used method, we try to list in detail the general objectives specified before. After that, the way in which measure compliance to standards or guidelines shall be specified. We have constructed the checklist for the UML static model, OMT classes and functional model. Structured model DFD was also taken into account. The next scheme was followed when constructing the mentioned checklist:

1. Identify the model that had been used in the asset documentation and the paradigm it belongs to
2. Represent in a list the model and language standard elements from the syntactic point of view
3. Associate the metric attributes that we are going to use to each of the elements collected in the list

We have selected attributes from the standard model or language elements in order to make the checklists, and have collected information about the attribute measures. The word *attribute* is used in the sense of asset aspects that we are going to measure in contrast to the attribute that is class part.
For example, for DFD flows we selected two attributes, the way they are identified and their representation.
We denote for X_{ik} the metric corresponding to the attribute i into the asset k. This metric is a part of the distance measure from the asset to an "ideal-model". A distance equal zero will be associated with assets according to all standards and guidelines [Fenton, 1997] and the higher value will be associated with assets that haven't any compliance with the standards.

Following the previous example, X_{1k} and X_{2k} denote the flow identification and representation, respectively, into the k asset. Both metrics, as is also the case of all DFD metrics, can take values 0,1 or 2. For each asset we must consider its metric values and their frequency distribution. In the case of identification attribute for DFD´s, when identification is expressive and unique the measurement will be zero, when it is unique but ambiguous will be 1, and 2 in other case.

We use an intermediary value between the best (when the standard is compliant) and the worst (when there isn't any standard) in order to asset qualification, as we are going to see in audit outputs.

✓*Exit criterion*: the audit shall be considered complete when the entire following situation arise:
- The asset has been examined and qualified
- The audit report with measures and conclusions has been prepared and recorded
- The report with recommendations about the audit's elements is completed

The asset developer knows, when this is possible, the audit findings and his (her) answers have been evaluated. We must consider that not always the author will be accessible, and then he (she) cannot do the corrections.

✓The *Output* contains two kind of information, one of them with the asset situation, and the other about the audit.
The asset situation includes the qualification in approval, contingent approval or disapproval, depending on the observed metrics. The distance from an asset to the "ideal-model" can be measure as 1 minus the proportion of observed zeroes, i.e. 1 minus the count of observed zeroes divided into the count of observed values.
The audit result for an asset will be approval if the distance from the asset to the "ideal-model" is zero, i.e. if it have all metric values equal zero. It will be disapproval if some metric have the higher value and contingent approval in other case. The reason for this classification is that higher values are consequence of the usage of incoherent terminology, and this will prevent us from a correct comprehension (or will cause misunderstanding).
Each asset will have an audit report which must include audit qualification, the error reports and conclusions summary, in the way as we show in result section.

The audit report will include a summary about the effort, errors classification and audited asset conclusions. Furthermore, it will include recommendations about the audit process and asset documentation guidelines.

Table 1

OMT assets	14 assets	5,17% with errors	0% with v&v documents	94,83% approval 5,17% contingent approval
DFD assets	28 assets	57,14% with errors	0% with v&v documents	42,86 % approval 28,57% contingent approval 28,57% disapproval

3. Results

The table 1 shows the summary of 42 audited assets. Note that OMT assets have a better qualification than the DFD assets, 94,83% approval against 42,86%. Within the DFD assets the 28,57% was disapproval.
When we consider all the audited assets, the 21,43% were asset disapproval. In the way we would afford more audited asset we may contrast these results in order to evaluate the disapproval or approval evolution, identifying the more conflictive assets.

It is a remarkable result the total omission of verification&validation documentation. This will constitute an explicit recommendation for all asset suppliers.
We have expended 8 minutes-person in each DFD asset revision. We considered in this measure only the revision time, but no the previous session. Probably this measure will change in the future as the auditor experience increases.

Figures 1 to 3 show the summary of audited assets. In order to their correct interpretation it must be taken into account that:

- Each radio gives us information about the asset which number is on the radio
- The higher radio value is 1 because in this axe we are representing relative frequencies
- We denote with $F(X_{ik}(j))$ the absolute frequency of value j corresponding to the asset k attribute i. The j range is 0,1,2. The range of k is 1..n, where n is the asset count, and the i range is 1..I, where I is the attribute count.

Figure 1 shows the zero relative frequency in each asset:

$$\frac{\sum_{i=1}^{I} F(X_{ik}(0))}{\sum_{i=1}^{I}\sum_{J=0}^{2} F(X_{ik}(j))}$$

Note that only if this relative frequency is 1 the asset will be approval, but if it is less than 1 we don't know if it is disapproval or contingent approval.

Figure 2 shows in each radio the assets correctness recording DFD flow representation and identification:

$$\frac{F(X_{ik}(0))}{\sum_{j=0}^{2} F(X_{ik}(j)}$$

We note that the flow identification is worse

$$\frac{\sum_{i=1}^{I} F(X_{ik}(j)}{\sum_{i=1}^{I}\sum_{j=0}^{2} F(X_{ik}(j)}$$

than the flow representation.

Figure 3 shows for each asset, the error relative frequency distribution. For j=1,2 it plots the following:

The assets 6 and 8 are the worst, and we can detect in this figure the disapproval assets looking for the legend "without standard"

4. Conclusions and future work

The asset qualification process requires a first confirmation about the asset well comprehension, without this, posterior activities loss any meaningfulness. This work has permitted us to know that the 78,57 % of the audited GIRO repository assets are comprehensible and 21,43% are not.
Furthermore, this work has showed that the assets are not verified or validated, or they are but they are not documented, which is a negative aspect for their reliability. We are conscious that the work only includes syntactic er-

rors and documentation completeness, excluding other important errors [Coogan, 1994]. But we can conclude that now we have asset knowledge which will permit to decide if an asset must abandon the qualification process or not, and which are the more frequent kind of errors.

The future work will permit to complete other checklist and audit all assets. We are thinking that the requirement assets will need to be audited, perhaps, from two different auditors. Furthermore, the assets that were approval or contingent approval will continue into the qualification process. In this way, our colleges from Murcia University are developing automatic tools for properties' formal verification and in Valladolid, there are several PFC in progress which purpose is the construction of automatic tools in order to measure design attributes, in assets developed using UML or OMT.

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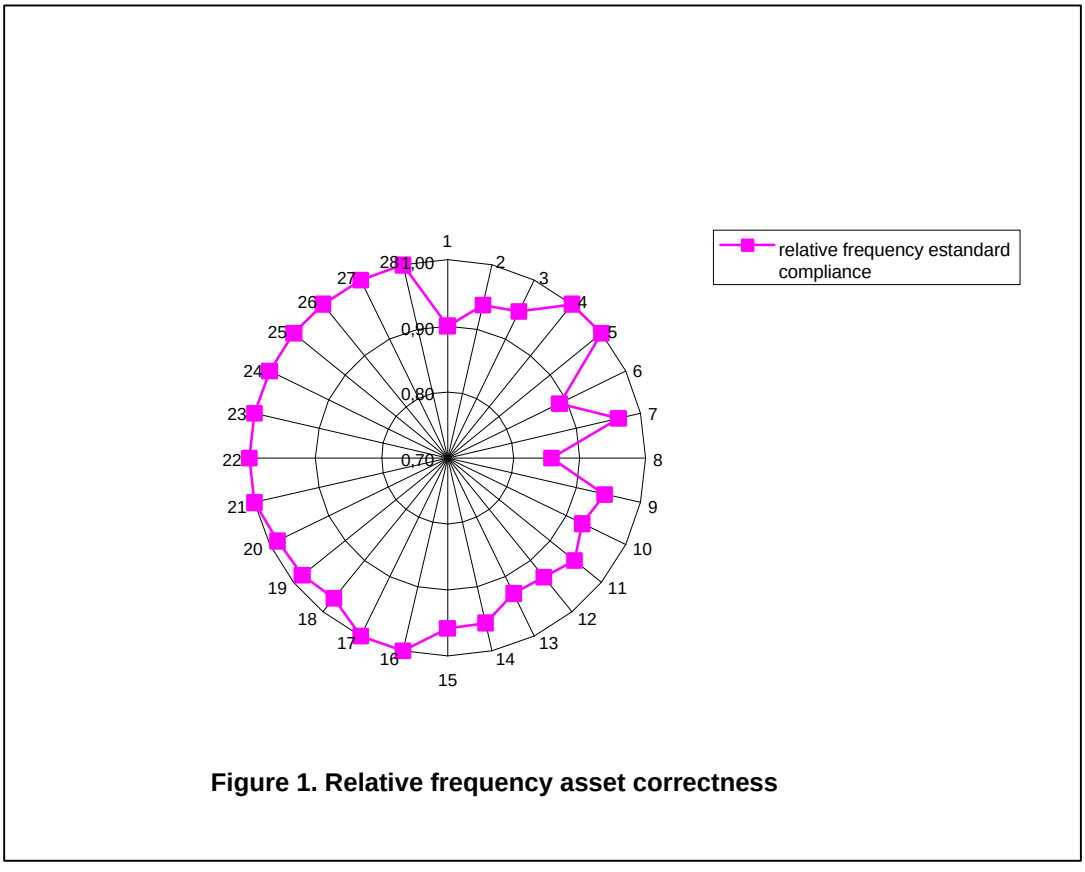

Figure 1. Relative frequency asset correctness

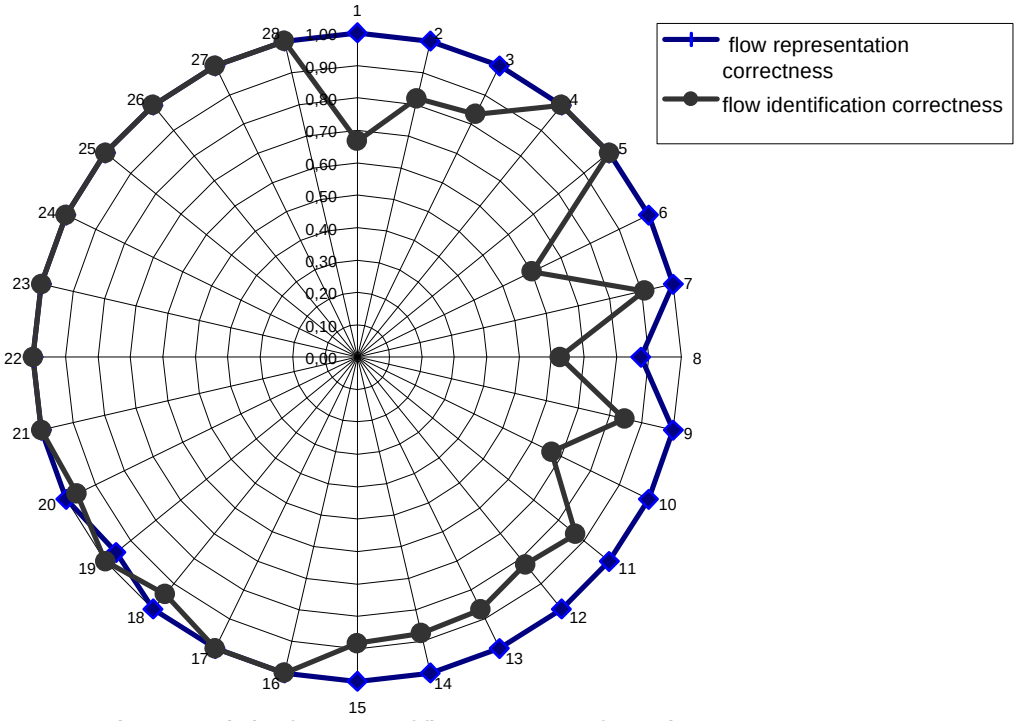

Figure 2. Relative frequency of flow correctness for each asset

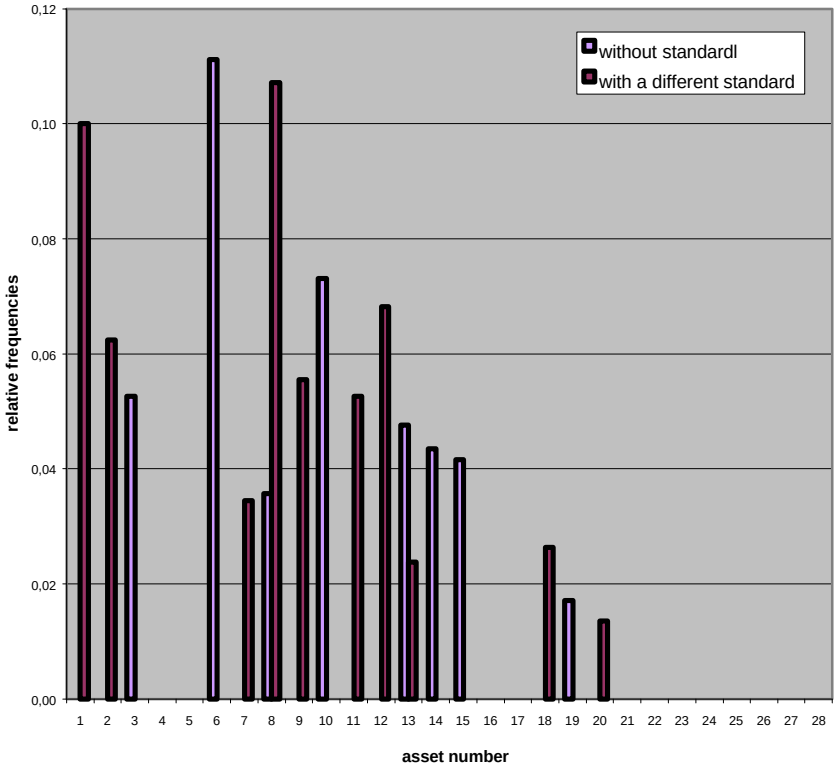

Figure 3. Error relative frecuency in each asset